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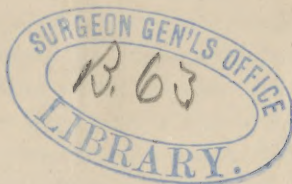
# REMARKS

ON SOME

ALGÆ FOUND IN THE WATER SUPPLIES OF  
THE CITY OF BOSTON.

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BY W. G. FARLOW.

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7. — *Remarks on some Algæ found in the Water Supplies of the City of Boston.* By W. G. FARLOW, Assistant Professor of Botany in Harvard University.

It will be remembered that, in the months of October and November, 1875, a peculiar taste was noticed in the drinking water of the City of Boston, which was generally described as resembling that of cucumbers. It is recorded that a similar taste was noticed in the autumn and winter of 1854; and, at that time, an investigation was made concerning its origin. The investigation, conducted by well-known chemists, did not result in assigning any definite cause for the taste; and in hinting that it might have arisen from Crustacea in which had been noticed a quantity of oil globules, the chemists were expressing an opinion which could only have weight when coming from a zoölogist.

When the taste reappeared in 1875, an examination of the water was made by Professor W. R. Nichols, Mr. Edward Burgess, and myself, to ascertain whether any substance known to chemistry, zoölogy, or botany, could have produced the peculiar cucumber taste. The results of our examinations are given in the "Report of the Cochituate Water Board," Boston, 1876; and it needs only be said, in this connection, that no assignable cause could be discovered, but that, as far as the botanical examination showed, the water was unusually pure; that from the Bradley Basin, where the cucumber taste was strong, being decidedly more free from vegetation, whether living or dead, than that from the Brookline Basin where the taste was not perceptible. Inasmuch as the subject of fresh-water algæ is a *terra incognita* to water boards, upon whom not unfrequently devolves the duty of explaining to the public the cause of various unpleasant smells and tastes, it seems not inappropriate to say a few words about what is known of the relation of those plants to smells and tastes, even if it should amount to a confession of a very considerable ignorance.

It has long been believed, by that part of the public which is interested in botany, that the algæ known as nostocs have a disagreeable odor, and, in many cases where unpleasant odors have arisen in bodies of water which serve as water supplies, it has been considered a sufficient explanation to say that the odor is produced by some nostoc-like plant, without, however, going so far as actually to find



the plant which is supposed to be a nostoc. Undoubtedly, the most disagreeable odor ever found in fresh water may be produced by nostocs, using that word to designate the order *Nostochineæ*; but by no means all of the disagreeable odors and tastes arise from that source. To return to the cucumber taste, there is not the slightest proof that it is caused by any algæ, either living or decaying. The water from the Bradley Basin showed no nostocs whatever, and no algæ of any kind not also found in waters which did not have the cucumber taste. During the past summer, we have made experiments to ascertain the taste produced by different species of algæ. For this purpose different species of *Desmidiæ*, *Confervæ*, and *Oscillariæ*, were allowed to stand several weeks in glass jars filled with pure water; but, in no instance, was any thing like a cucumber taste produced, nor, in fact, was any describable taste perceived.

As far as smells are concerned, our knowledge is more complete. It is known that, when living, different species of nostoc may produce two different kinds of disagreeable odors: first, an indescribably suffocating odor, as in the case of several *Lyngbyæ* and *Oscillariæ*; and secondly, a sulphurous odor, as is given off by species of *Beggiatoa*. A still more disagreeable odor is given off by species of nostoc in decay, an odor resembling that of a pig-pen or very strong horse-dung. Most persons who have in midsummer walked through the bogs so common in New England must have recognized the stifling odor given off by the bluish-green masses growing on the mud or in shallow water. These are usually species of *Oscillaria*, composed of filaments made up of small cells in rows, the filaments capable of moving on one another, so that, when placed on any flat surface, they push out from one another, and spread over a larger area, or, if placed on the bottom of a tumbler, they crawl up the sides. The chemical nature of the stifling odor is not known. This peculiar stifling quality is not peculiar to nostocs, or even to fresh-water plants. It is marked in several marine plants, as *Polysiphonia fastigiata*, which forms blackish tufts on the larger rock-weed.

The algæ which exhale sulphurous odors belong to the genus *Beggiatoa*, which resembles *Oscillaria* in consisting of filaments endowed with motion, but which differs in color, being whitish, the cells being full of opaque granules. They look to the naked eye like white films covering decaying algæ and other plants. They are found on

the sea-shore as well as in fresh water, but are particularly common in hot springs. Cohn has shown that the peculiar exhalations of hot sulphur springs are owing to the growth of species of *Beggiatoa*,\* which depend for their existence upon, at least, two conditions; the presence of a large amount of sulphur in the water, and the absence of iron. Cohn confirms the observations of Cramer, that the dark granules in species of *Beggiatoa* consist of sulphur. When *Beggiatoa* filaments are heated, the granules fuse into large yellowish drops and a sulphurous odor is developed. If the filaments are treated with sulphide of carbon, the granules are dissolved, and then the cell partitions become for the first time visible.

The odor produced by decaying algæ of the order *Nostochineæ* was brought most strikingly to our notice during the last summer. In the month of August, we were asked to examine the waters of Horn Pond, situated in the town of Woburn, nine or ten miles from Boston, and the head-waters of what is known as the Mystic basin, which supplies Charlestown and East Boston. It was stated that a disgusting odor, said to resemble that of a pig-pen, had appeared in several portions of the pond. On inquiry, we found that there had been a quantity of a plant called eel-grass washed ashore, and upon it was a slimy mass from which the odor seemed to proceed. The slimy masses were not limited to any particular part of the pond, and, although very abundant at the upper end, they were also common at the outlet. At the time of our visit they were said to be by no means as numerous as two or three days before. The eel-grass, so called, to our great surprise, proved to be not what is generally known by that name (*Vallisneria spiralis*) or even any of the common pond-weeds (*Potamogeton*, *Myriophyllum*, *Ceratophyllum*), but a new species of *Plectonema*,† of the order *Nostochineæ*, which we had never seen growing

\* For an account of the physiological and chemical relations of the genus *Beggiatoa*, vid. "Beiträge zur Biologie der Pflanzen," by Cohn, Vol. 1, Part III., pp. 172-180, where references are given to the earlier writings of Cohn and others on this subject.

† *Plectonema Wollei*, n. sp. Trichomatibus atro-viridibus in massas pluripedales intricate coalitis; ramis parvis obtuse exeuntibus plerumque singulis rarissime geminatis. Trichom. diam. .00388 m. m.; c. vagina .00405; articulis circa .000485 m. m. latitudine. Species magnitudine et ramis parvis facile distincta. Species generis nobilissima a cel. Wolle prope Bethlehem in Pennsylvania primum inventa est. Ad Horn Pond prope Boston detexi. Species a cel. Rabenhorst in Algis Europæis, no. 2440, sub nomine *Lyngbya Wollei*, Farlow, distributa est.



before, and which was first observed by the Rev. Francis Wolle in the waters near Bethlehem, Pa. It grew in great abundance at the head of the pond where the water was shallow, attached to other plants and sticks, and spread over the surface in areas of several square feet, forming blackish green patches like the plant called mermaid's hair (*Lyngbya majuscula*) on the sea coast, only very much more luxuriant. Where the *Plectonema* was free from the slimy substance, it emitted the suffocating smell of many of the *Oscillariæ*, but was free from the pig-pen odor.

In various places along the edge of the pond, and in some places where the *Plectonema* came to the surface, were masses of slime, at first of a pale bluish-green, afterwards of a brownish color. The odor was most disgusting, and resembled rotting horse-dung to such an extent that it was difficult to believe that it came from a vegetable substance. A microscopic examination showed that the slime was composed of an amorphous mucus, in which were the threads composed of the heterocysts and hormogoniæ peculiar to the *Nostocs* proper, but, unfortunately, in a too advanced stage of decomposition to be specifically determined. An examination of the water of the pond showed it to be full of little rods, which shone in the sunlight. These rods had the same microscopic structure as the filaments of the slimy masses which were evidently aggregations of decaying filaments, which, in a normal condition, float freely in the water. At the time of our visit, however, even the filaments which were still floating, were so far disintegrated that, after an unavoidable journey of several hours in the cars, they were not in a condition to be specifically determined. We are entitled to assume that the alga was a species of *Anabæna* or some nearly related genus, perhaps *Nodularia litorea*, Thuret, the decomposition of large quantities of which produced an intensely disagreeable odor near Deauville, Normandy, in August, 1874, as we learn from Dr. Bornet.

Early in October, we again visited Horn Pond, with the purpose of obtaining some of the *Anabæna*, if possible. It had, however, completely disappeared. Furthermore, the *Plectonema*, which in August was attached, was washed ashore in immense quantities, leaving the surface of the pond clear. A quantity of the *Plectonema* was kept for some time until it began to decay, when that too began to give off an odor of pig-pen, which could hardly have arisen from any remains of

the *Anabæna*, as a microscopic examination showed no traces of it. It would seem then that the peculiar odor, which was so marked in the case of Horn Pond, may arise from decay of more than one species of the *Nostochineæ*, and the probability is that a large number of species may produce it. The important point is, that it is during their decay that the odor is found; not while they are growing. The question arises as to what killed the algæ so suddenly. Those living near the pond are quite ready to believe that it was the refuse from the tanneries, but there is no proof whatever that that was of a different character from what it had been previously, and the question is still open, why at that particular time the algæ were killed. It will be remembered that, during the month of August, 1876, the heat was excessive, and the temperature of the surface water was raised considerably. We cannot doubt that the broiling rays of the sun had a destructive effect on the *Anabæna*, especially that which was caught in the meshes of the *Plectonema*, and, by the falling of the water consequent upon the drought, exposed on the surface.

From the preceding account of the condition of Horn Pond, we are warranted in drawing certain conclusions which may on some occasion prove useful to water boards. If a sudden odor of pig-pen arises, it is in all probability owing to the decay of large quantities of some algæ of the nostoc family, and most probably one of the finer species diffused through the water. As the decay is generally, if not always, brought about by causes beyond human control, it is useless to try to stop it when it has once begun. On the other hand, there is no occasion for great alarm; for, when they have once begun to decay, algæ like *Anabæna* disappear in a few days. In the case of Horn Pond, we understand that the odor lasted barely a week from the time when it was first perceptible. As to the possibility of the putrescent masses being carried any great distance, in the case of Horn Pond it was found that they advanced as far as Winchester, not more than two miles in a direct course, but were not found farther on. They never made their appearance in Charlestown or East Boston. Knowing that floating algæ are caught in the meshes of *Plectonema* and other similar filamentous algæ, and thus, during the sinking of the water, which usually occurs in July and August, exposed on the surface to the direct heat of the sun's rays, which cause them to decompose, it is evident that it is a useful precaution to remove, as far as possible, the



long filamentous algæ and fine-leaved phanerogams. No plant of our waters is of such large size, or of such fine meshes, as the *Plectonema Wollei*, which, although as yet recorded in only two localities, will probably prove common enough. It is a summer plant, and does not attain considerable dimensions before July. It starts on the stems, leaves, and old sticks on the bottom, and forms coils several feet in length. On reaching the surface, it expands over considerable areas. In the latter part of September, it breaks away from its attachments, drifts ashore, and disappears to return the next summer.

In conclusion, a word about another plant common at Horn Pond, and which has been sent to us from several localities, with inquiry as to its nature. It forms a bluish or yellowish green scum on the water, often spread over a considerable area. Were it not that it forms such a thin layer, it could be collected in large quantities. Kept in bottles, it multiplies and forms irregular masses of a pea-green color and mealy consistency. At first solid, the superficial cells imbedded in a gelatinous mass increase rapidly, and it becomes hollow. Then certain portions project like buds, and finally separate from the mother plant, which seems to be perforated. This plant, *Clathrocystis æruginosa*,\* was described by Henfrey, and is now classed by Cohn amongst the Bacteria, and placed near *Clathrocystis roseo-persicina*, a plant which forms purplish red films on decaying algæ, and on the ground along our coast, and which in Europe is also found in fresh water, but it has not yet been found in the interior of our own country. We mention it from its frequent occurrence, and because it has been supposed to injure the water in some places. There is no account of any injury having been done to man; but in Germany, where it is known as the *Wasserblüthe*, it has been destructive to fishes. Cohn † suggests that the slimy substance of which it consists, forms a coating over the fish, and shuts off the supply of air necessary to support life. Professor Hagen, of Cambridge, suggests, as a remedy, the introduction of snails into water where it occurs, as they are extremely voracious, and eat large quantities of fresh-water algæ.

\* "Trans. of the Microscopical Society of London," 1856.

† "Aus neuester, wie aus älterer Zeit besitzen wir Nachrichten, dass die Fische in einem Teiche, welcher mit der Wasserblüthe dieser alge sich bedeckt, massenhaft absterben; vielleicht wird durch die dicke Schleimhaut die Aufnahme des für das Athmen der Fische unentbehrlichen Sauerstoffs aus der Luft gehemmt." Beitrage zur Biologie, Vol. 1, Part III., p. 155.